White Paper
Sustainability and ICT.

The greening of business.

T · · Systems · · ·

Content.

1. Introduction.

All over the world, IT is playing an increasingly important role—both in the world of business, and individuals' private lives. As a result, IT is consuming ever greater amounts of energy, and is a major source of carbon emissions. Did you know, for example, that in 2011 approximately $ 46 bn was spent on cooling IT hardware?

Google has revealed its global electricity consumption and greenhouse gas emissions. Google consumed 2.26 bn kWh of electricity—it is roughly equivalent to 200,000 homes in America. [Mercury News 2011]

Ecology has taken 250 years to go mainstream.

[Zukunftsinstitut 2010]

As a result, economic imperatives are a key reason why sustainability is driving growth in the IT market. With the keyword Green IT the ecological aspects of sustainability are addressed. "We need to make consumers more aware of the importance of Green IT, and to promote our ideas," explains Cornelia Rogall-Grothe, Federal German Government Commissioner for Information Technology, with an eye to the EU's 20/20/20 energy-saving objectives.

So where do we stand today with Green IT? According to Dr. Stefan Heng (Deutsche Bank Research): "The hype and initial fascination among business and political leaders have given way to a rational exploration of the issues," [BITKOM 2010/1]. And the focus is not merely on "The greening of IT" but also on preserving precious resources by deploying IT throughout all areas of the economy, i.e. "Greening through IT."

"Green IT" is what analysts, vendors and providers call all IT solutions that save energy within business organizations. These solutions include hardware, software and services. Where hardware is concerned, energy-efficient desktop PCs, thin-client architectures and data-center hardware offer answers, and so do energy supply and cooling systems. In the software and service arena, significant potential lies in virtualization, in solutions for scalable capacity management, in data-center planning, and in storage-system offshoring. The increasing convergence of IT and telecommunications also needs to be considered. And Green IT needs to be combined with energy-efficient solutions based on telecommunications, such as videoconferencing: Against this background, Green IT is fast evolving into Green ICT.

Green ICT also extends to other, less commonly considered aspects of the entire life cycle. This includes eco-friendly procurement, employee behavior, running data centers on sustainably generated energy, environmentally sound disposal of used electrical equipment, and as much recycling as possible. ICT is not intrinsically "green", because it itself consumes energy and resources. But ICT can be leveraged to make business processes more energy-efficient, generating savings over and above the power input required for ICT itself.

Green ICT is about how users and providers address the ecological impact of ICT usage.

This white paper is designed to help companies raise in-house awareness of Green ICT and its possibilities, reduce their carbon emissions, and enhance their success in environmental and business terms. We provide some food for thought, show the value that Green ICT adds, and describe possible approaches for office desktop environments and data centers, both of which have central importance, and the associated business processes. We conclude by presenting a number of successful Green ICT projects and providing information on initiatives, additional reading, and options for taking action in connection with Green ICT.

2. Adding Value with Green ICT.

Business motivation for Green ICT investment.

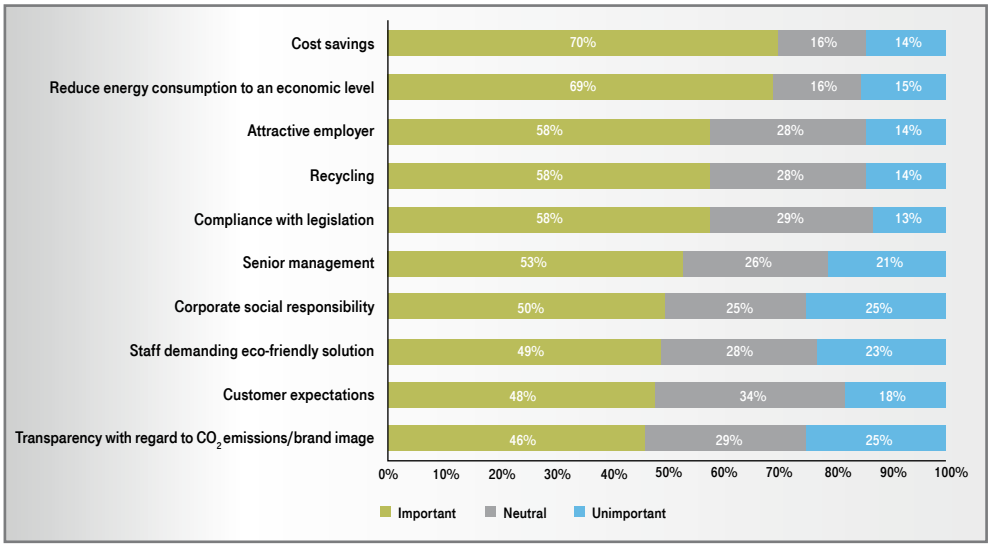

Fig. 1. Source: Bund 2011.

Businesses continue to consume more and more energy – and to emit ever greater amounts of greenhouse gases. Fortunately, increasing numbers of corporations are addressing the issues associated with their carbon footprints. 73% of the Global 500 now voluntarily provide figures on their greenhouse emissions, and 50 % have undertaken commitments to paring back those emissions [CDP 2010]. These efforts are to be seen in the context of a general move towards greater corporate social responsibility, but also in the light of the high priority given to cutting costs – not least because energy has become an ever greater burden on corporate budgets. Green ICT allows companies to reduce ongoing expenditure, in particular by means of more energy-efficient hardware and the intelligent utilization of infrastructure, leading to lower consumption of power and materials.

As a result, many providers place extreme emphasis on savings, and that cost is generally the subject highest on everyone's minds when first considering the concept of Green ICT. However, the motivation for exploring the issue is far more nuanced. And enterprises are well advised to avoid a piecemeal or one-sided approach. All activities need to be coordinated within the scope of a comprehensive Green ICT strategy, taking into account other parameters, over and above simply cost cutting and reduced power consumption.

For example, a green reputation can improve a company's standing with capital markets and with society as a whole. What's more, this can bolster employee loyalty and satisfaction, and help attract new types of customers.

In fact, giving due consideration to environmental concerns can generate tangible competitive advantage, as many customers now pay close attention to sustainability, and this can influence their purchase decisions. A majority of consumers are, for example, willing to pay a higher price for environmentally sound ICT devices (see Fig. 2). This can appeal in particular to emerging target groups, such as LOHAS (Lifestyle of Health and Sustainability), who regard sustainability and social responsibility as cornerstones of their lifestyle and consumer behavior. But existing customers, too, are sensitive to

70 % of businesses in Germany believe potential cost savings are the most important aspect of Green ICT.

[Bund 2011]

Green ICT: environmental awareness is changing high-tech markets.

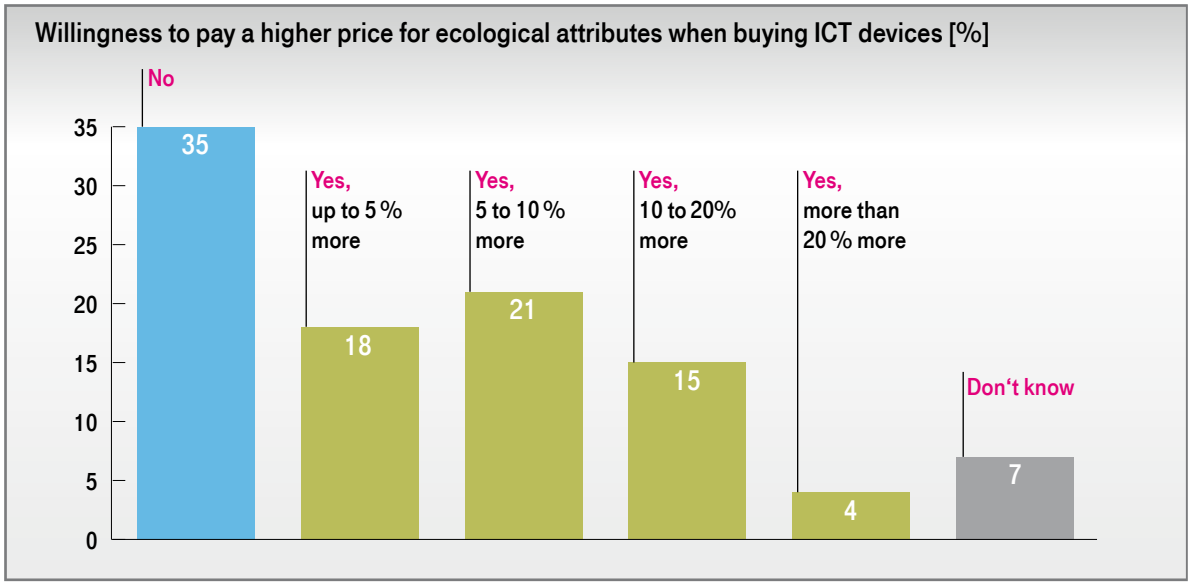

Fig. 2. Source: Zukunftsinstitut 2010.

Green ICT issues; the right approach can therefore raise their satisfaction and loyalty.

Companies' efforts to fulfill their social responsibilities are also acknowledged outside the directly addressable customer target group. Increasingly, attention is being paid to whether a business's operations are ecologically sound, and their ICT usage sustainable, making them key aspects of a comprehensive corporate social responsibility (CSR) strategy. They are key factors in improving brand value and public image. Cultivating a good relationship with nongovernmental organizations (NGOs) such as Greenpeace – either by conducting joint projects or being cited as good examples by them – is positive for a company's image, as is a high position in rankings such as the Dow Jones Sustainability Index or the Climate Disclosure Leadership Index of the Carbon Disclosure Projects.

With regard to developments to date and those expected in the future, the growing interest of investors would seem to be, in the truest sense of the word, sustainable, and not simply a flash in the pan. [BITKOM 2010/1]

A further criterion will, in the future, be the need to comply with new legislation.

Moreover, CSR activities are being given ever greater weight by many rating agencies. The deployment of Green ICT can, therefore, have an impact on stock price and company value, and heighten the company's attractiveness on capital markets. Social and ecological factors are also becoming more influential when it comes to investment decisions on the part of the general public. The 357 sustainable investment funds based in Central Europe that aim not simply to maximize returns, but to embrace environmental and ethical principles, managed total assets worth € 34.4 bn in 2011, triple the figure for 2005.

In addition, carbon emission certificates are gaining in importance. Bloomberg has forecast strong growth in the global market for these certificates from 2012. Trading in emissions rights could sharply reduce the time for payback on investments made in climate-friendly technology and low-carbon data centers.

But an effective Green ICT strategy does not just have an external impact; it also has internal repercussions. A clear commitment to corporate social responsibility is an important factor when it comes to recruiting new staff in the "war for talent". In addition, studies have shown that employees prefer to work for an environmentally aware organization. This increases trust, loyalty and work satisfaction.

The hype surrounding the initial fascination with the technology has therefore given way to a more rational exploration of the concept of Green ICT and sustainability. In other words, the aim is to both green IT, and to harness the greening effect of IT – and also to make business processes per se more (energy-) efficient.

Development of trading volume for carbon emission certificates according to Bloomberg.

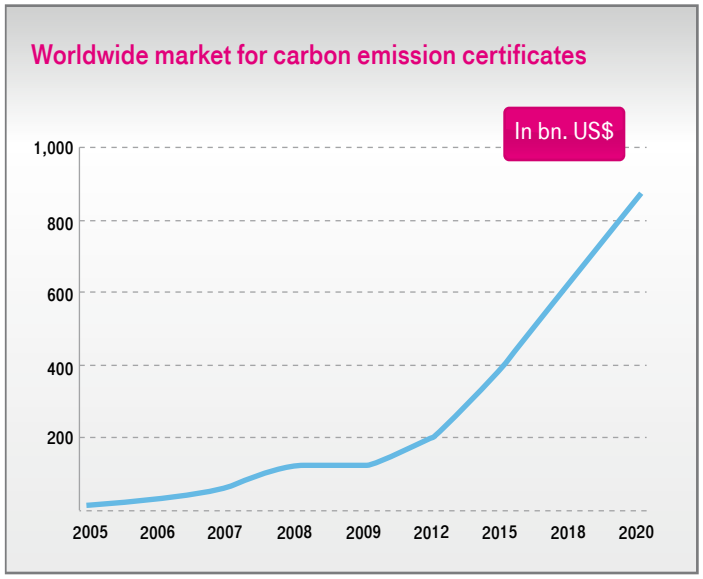

Fig. 3. Source: Zukunftsinstitut 2010.

3. How can businesses make their ICT more sustainable?

This section shows you how you can improve energy efficiency by means of ICT. A closer look at ICT-generated carbon emissions reveals two main culprits: office desktop landscapes and data centers. No less than 40 % of emissions are caused by desktop computers and their monitors, and another 23 % by servers and cooling systems. We will therefore begin by discussing ways for Green ICT to reduce CO_2 emissions in office environments (see section 3.1) and in data centers (see section 3.2).

When effectively and comprehensively applied, Green ICT can contribute much more to environmental protection than simply reducing ICT-generated emissions. Green ICT can improve business processes that are not directly involved in ICT, and dramatically lower CO_2 emissions throughout the process chain (see section 3.3). It is here that its true potential becomes apparent: according to Gartner, ICT now accounts about 2 % of total global CO_2 emissions. But Green ICT can also help significantly reduce the other 98 % of all emissions not caused by ICT.

3.1 Green ICT in office environments.

3.1.1 Role-based desktops systems.

The approximately 26.5 m desktop systems that populate German companies, government agencies, schools and universities annually consume around 4 TWh more electrical power than a large coal-fired power station can generate in the same period [BITKOM 2010/1]. And according to the Fraunhofer Institute, there will be a further rise in ICT energy consumption of at least 20 % by 2020.

The time for action is therefore now: Each and every office desktop offers opportunities to save energy. Even without any new technology, significant savings can be realized by encouraging office workers to change their habits. Policies can be developed and published that make employees aware of how they can contribute: for example, through the use of hibernation mode and power-management software for hardware; duplex printing; and avoiding unnecessary printouts.

However, companies are still deploying too many devices for printing, faxing, copying and scanning. In the services industry, for example, there are an average 5.3 peripherals for every IT user [Lexta 2011]. This complex landscape often leads to a lack of transparency, and there are often no accurate figures available on total cost of operating all this hardware. However, the ratio of users to devices can be significantly improved by analyzing the current infrastructure and actual user requirements: then changes can be made to the type, number and position of devices, ensuring better utilization of available assets, and reducing stand-by and idle times.

Gartner analysts believe that implementing central power management alone could save a company with some 2,500 computers more than $ 43,000 annually. [COWO 2009]

Reducing the number of devices is an important goal, but a further key objective is to minimize paper consumption. Businesses are faced with a deluge of documentation. Each and every day, a typical corporation sends, prints and archives thousands of letters, faxes, and emails. And that ties up human resources and capital. But there is an alternative – it is possible to entrust the management of the entire document process, from digitization, to archiving, to distribution vie email or post, or the generation of website content, to an external specialist, and to create an entirely digital workflow. The upshot is economies of scale in terms of computing resources, for example for archiving. And far less printed paper, as a result of digital pay slips and invoices, that can be sent electronically – including robust encryption (for example by means of the DeMail system from Deutsche Telekom). With digital workflows, processes that were previously entirely paper-based can be made far more efficient, and far more eco-friendly. A further prime example is the innovative Paper & Pen solution from T-Systems. Using a special pen with a built-in camera, this allows the capture and subsequent processing of handwriting and signatures, for example on contracts. The pen creates a “carbon copy” of the handwriting within the pen itself. The customer can retain the original signed document, the digital copy is transmitted wirelessly to a central server, where it is archived: there is no need for documents to be sent by post, and there is only half the amount of printed paper. There is therefore a corresponding reduction in carbon emissions for the manufacture, shipment and mailing of the paper.

Potential savings through thin clients.

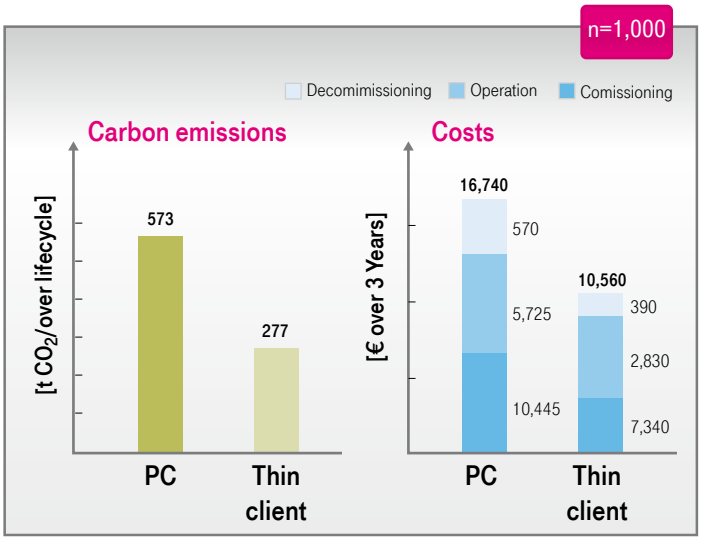

Fig. 4. Based on Fraunhofer UMSICHT.

Resources can be conserved not only by the more energy-conscious use of electronic equipment, but also by the deployment of products that are themselves inherently more energy-efficient. However, making available a pool of devices that are both powerful and at the same time energy- and cost-efficient is a herculean and ongoing challenge for CIOs. One approach is outsourcing – either selectively, of individual aspects, or comprehensively, in the shape of the entire ICT office landscape.

This offers a simple way of reducing the number of desktop systems and printers, and maximizing their efficiency. The key to the efficient provisioning of desktop ICT environments is aligning the tasks and roles of employees with the infrastructure. A C-level executive, for example, generally has very different needs from those of an office clerk or a call center agent.

To minimize idle computing resources and infrastructure, it is essential to plan the deployment and operation of devices in accordance with the role of the employee. The configuration and lifecycle of desktop systems should be based on a set of predefined user profiles. If the employee changes role, then the necessary changes should be performed automatically. Predefined roles allow the right balance to be struck between personalization and economies of scale – not only improving user satisfaction but also reducing the amount of energy required for hardware procurement, operation and maintenance. And if devices are regularly replaced with more energy-efficient products, and hardware that remains idle for a significant time removed, then further significant savings can be made.

A recent study of desktop computer solutions and their development between now and 2020 conducted by the Borderstep Institute on behalf of the German Federal Ministry for the Environment uncovered a further intriguing aspect of future desktop environments: There is a clear and gathering trend towards central software provisioning. This means that by 2020, only around 25 % of applications in German offices will actually be running on end-user devices – the remainder will be in data centers or in the cloud [BITKOM 2010/2]. Therefore, thin clients will be more than sufficient for most roles within business organizations. They are smaller, quieter and more durable than their fatter counterparts. A Fraunhofer study found that thin clients are much more energy-efficient than conventional desktop PCs, reducing carbon emissions and the cost of purchase and operation. Replacing a desktop PC with a thin client slashes desktop-system CO_2 emissions by over 54 %. Even if a LCD monitor is factored into the equation, the savings total an impressive 44%. Thin clients are much lighter and more compact, and consist of fewer components – yielding benefits with regard to transportation, disposal, and material inputs.

Here is a sample calculation: a company with 1,000 workstations that equips 75 % of them with thin clients can prevent the emission of about 67 metric tons of CO_2 per year. This is the amount of CO_2 that a Mercedes E-Class (with CO_2 emissions of 160g/km) would emit if it traveled a distance of 416,250 kilometers (10 times the circumference of the earth).

Companies should therefore ask which devices are really necessary for an employee to adequately perform their work tasks.

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A special USB dongle can also be a useful addition to a thin-client approach. This dongle enables the employee to access his own desktop environment from any computer with Internet access. This is ideal for shared-desk concepts. It increases desktop flexibility, reduces the number of hardware devices required, and the associated costs and direct carbon emissions. Moreover, it will encourage more staff members to work from home, and more frequently, trimming emissions further. This model is also ideal for businesses that make use of freelance specialists, for example development engineers working on projects in the automotive industry, or for part-time teleworkers who use their own personal PCs at home.

3.1.2 Mobility and Collaboration.

Just getting to and from the office inflicts considerable burdens on the environment: millions of commuters spend hours every day on roads. In Germany, commutes are responsible for 20 % of the entire volume of personal transportation, and by 2020 will account for approximately 2% of all emissions in the country. This adds up to an immense amount of exhaust gases. Then there are extra trips to business meetings, whether it is for a one-hour discussion with a supplier or a week-long strategy conference. All this travel is not just responsible for significant emissions, it is also expensive. The German Business Travel Management Association (VDR) estimates that there are approximately 163 m business trips made in Germany each year – almost half of them with same-day return journeys. And it is precisely these short trips that can be effectively replaced by telecommunications solutions that enable remote collaboration. This not only applies to major corporations; high-quality systems are now available for small and medium-sized enterprises, accounting for about 80 % of all business travel.

In office environments, there is a long and established practice of replacing conventional means of communication with ICT applications. To a large extent, hardcopy letters (along with the corresponding paper, transportation and logistics) have been replaced by e-mail and texting. A new generation of communication and collaboration tools allows people to work together irrespective of their location, without any loss of quality. Videoconferencing systems enable realistic face-to-face interaction, and state-of-the-art collaboration tools permit concurrent shared access to—and editing of—documents, presentations and more. This means it is possible to hold virtual meetings that are just as good as any physical meeting.

These tools support telecommuting and can effectively replace many business trips.

Videoconferencing is the most interactive form of virtual communication. After being used sporadically for years, recent innovations have finally led to their broad acceptance. Various versions of this medium now allow people to collaborate in virtually any situation, irrespective of their geographical locations.

If an office worker spends just one day a week working from home, they typically save 40 kilometers in commuter travel, reducing their carbon footprint by up to 295 kilograms annually.

Business travel in Germany.

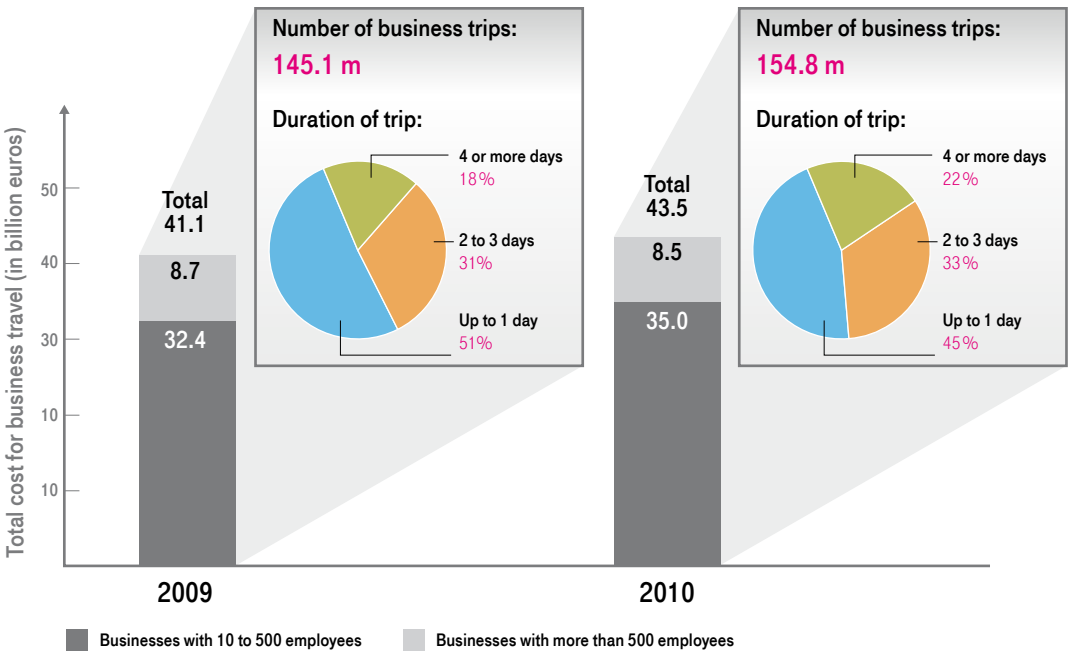


Fig. 5. Source: VDR 2011.

The thirst for mobility is unquenched and growing. And the car remains the number one means of transport. Cars account for more than five trillion person-kilometers annually in the member states of the European Union. [Zukunftsinstitut 2010]

It is important to minimize, wherever reasonable, travel and therefore emissions. That these efforts are financially worthwhile is borne out by an example of videoconferencing, successfully implemented by the mobile communications division of Deutsche Telekom. Around 3,000 employees use videoconferencing rather than physical travel, generating savings that recouped the initial investment within a matter of just four months. In the 24 months following the system's introduction, approximately 40,000 videoconferences took place, reducing carbon emissions from air travel by approximately 7,000 metric tons.

If one in two business trips in Europe were to be substituted by a videoconference. Then according to figures based on WWF research, this would pare back carbon emissions by almost the same amount as are produced by all cars driven in Germany.

[BITKOM 2010/3]

Virtual communication and collaboration tools enable genuinely global teamwork - in real-time. This can cut travel by up to 30 %, with a corresponding drop in carbon emissions, not to mention in costs.

3.2 Potential energy savings in data centers.

Did you know that there are more than 3 m data centers in the world? Germany's data centers alone consume over 10 terawatt hours (TWh) of power a year. Around 15 power plants, with an output of 1,000 megawatts each, would be needed to supply these data centers with electricity. In total, the electricity used to operate data centers costs approximately € 1.12 bn every year. According to a recent analysis by the Experton Group, "normal" data centers offer potential for energy savings of up to 60 %.

Another crucial factor is load. According to Experton, servers in well-organized environments with UNIX machines operate at just 35 to 45 % of capacity; with Intel servers, the figure is even lower, at 15 to 30 %. On average, only 25 to 40 % of data storage capacity is used. Server and storage virtualization solutions, however, make server loads of up to 80 % possible, regardless of the operating system. As for storage, 60 to 80 % is feasible, depending on volatility (the faster demand rises, the lower the available load, in order to retain sufficient reserves).

Virtualization and extensive standardization of services, for example through Dynamic Services, can maximize utilization of data-center resources. This involves creating logical systems that are independent of the underlying physical assets. Instead of being dedicated to specific purposes, resources are shared and therefore used more efficiently. The ability to intelligently assign and administer resources is therefore a key function within any virtualization solution. It ensures maximum flexibility in resource allocation. Scores of superfluous servers that were formerly largely idle can be shut down, maximizing savings.

Potential data-center savings.

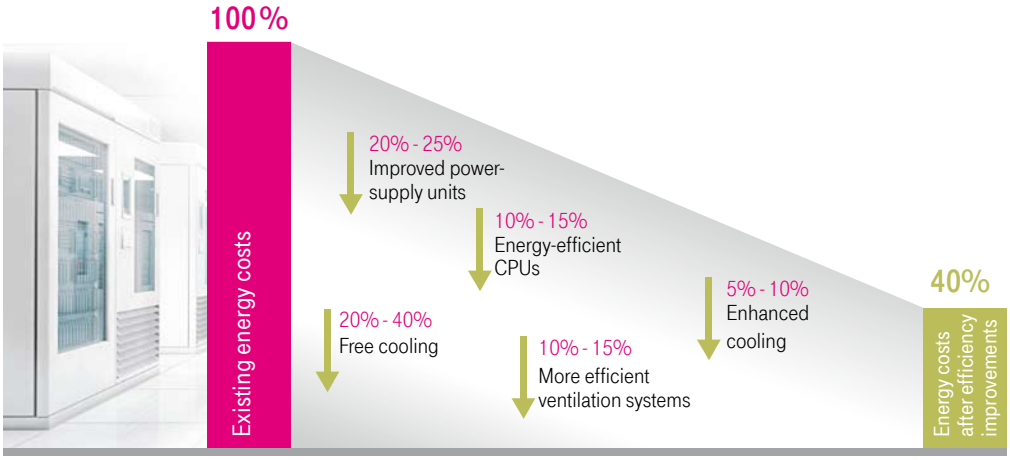


Fig. 6. Based on Experton Group 2011.

Virtualization reduces total costs by deploying resources more efficiently, in particular through the following:

- Efficient infrastructure management.
- Simpler migration, backups and data recovery.
- Reliable server operations: Multiple operating systems run parallel but are segregated from each other.

Cloud-based infrastructure is more efficient, but it could be greener.

[Forrester 2011]

To create a truly energy-saving solution, network infrastructure requirements and additional security efforts also need to be taken into account. Scaling up capacity will become easier as virtual server and storage resources are centrally managed.

The notion that virtualization is automatically greener is not, however, always accurate. Poor, inefficient management of cloud services and inadequate assessment of resources does not always bring companies closer to their eco-friendly goals. To create a green cloud, you need optimized capacity planning and a high degree of automation. This enables a continual reduction in physical servers; plus systems not currently in use can be switched off. When they are needed again, they must be up and running quickly and efficiently. This means that the existing infrastructure needs to support dynamic operation.

Winner of the Green IT Award from IDC and industry magazine Monitor: T-Systems' Green Dynamics model impressed the judges by setting new standards in the resource optimization of data centers. [IDC 2008]

And when these internal factors are complemented by smart systems, you get a green cloud-computing data center. Analyses in this area, for example into efficient cooling, are currently being carried out as part of the Datacenter 2020 project (http://www.datacenter2020.de). The study found that data centers' energy consumption can be significantly reduced via targeted server cooling. The researchers are considering multiple factors, including the intelligent integration of servers into the building infrastructure, and use of renewable energies. The results are being used to optimize existing data centers, and will also pave the way for designing and building the data centers of tomorrow [T-Systems and Intel 2010].

Current degree of virtualization in enterprises.

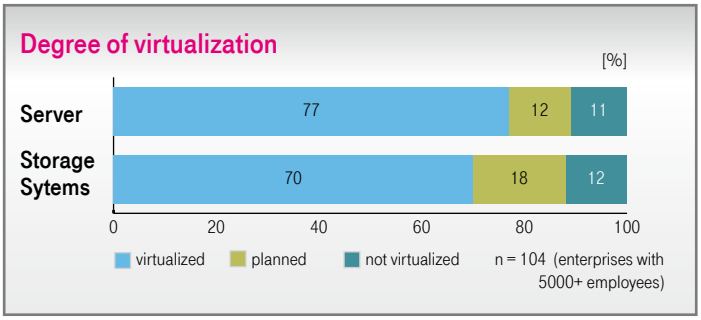


Fig. 7. Source: Experton Group 2011.

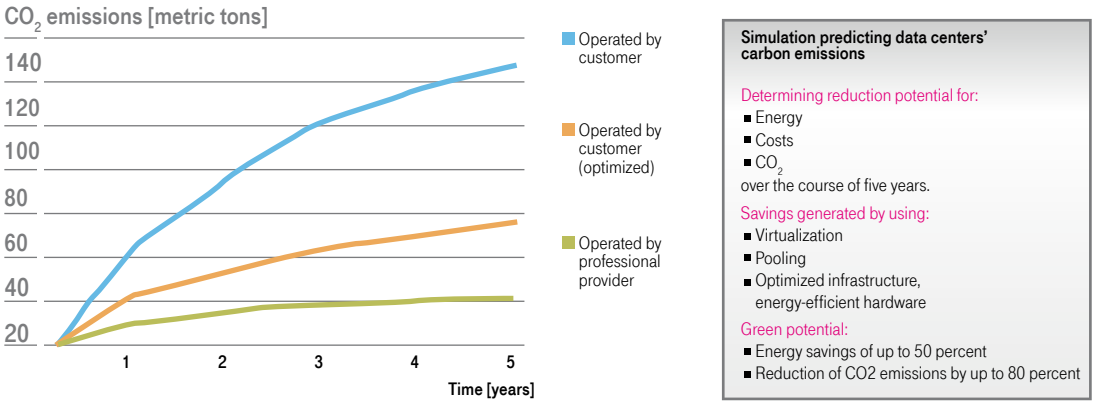
Focus: the Green Dynamics model.

To create greater visibility for CIOs, T-Systems teamed up with Dr. Christian Hölzl (Communications and Simulation Engineering, St. Pölten University of Applied Sciences) to develop the Green Dynamics model, which identifies and analyzes the various factors that influence energy consumption in data centers. These include different degrees of virtualization, pooling, and improvement of the PUE (power usage effectiveness) metric. The physical resources considered include computing power, CPUs, data storage and other assets.

The model avoids excessive complexity for the sake of transparency and ease of comprehension, and enables decision-makers to quickly and effectively evaluate the current situation, and identify opportunities for improvement. It therefore makes it easier to make Green ICT decisions without overlooking important factors, and reveals potential for lowering CO_2 emissions. The following example demonstrates the model's value as a decision-making tool.

Green Dynamics model.

The Green Dynamics model simulates ICT processes to make a prognosis about data centers' carbon emissions over the course of five years. It makes it possible to compare existing structures with optimized ones.



Simulation predicting data centers' carbon emissions

Determining reduction potential for:
- Energy
- Costs
- CO_2

over the course of five years.

Savings generated by using:
- Virtualization
- Pooling
- Optimized infrastructure, energy-efficient hardware

Green potential:
- Energy savings of up to 50 percent
- Reduction of CO2 emissions by up to 80 percent

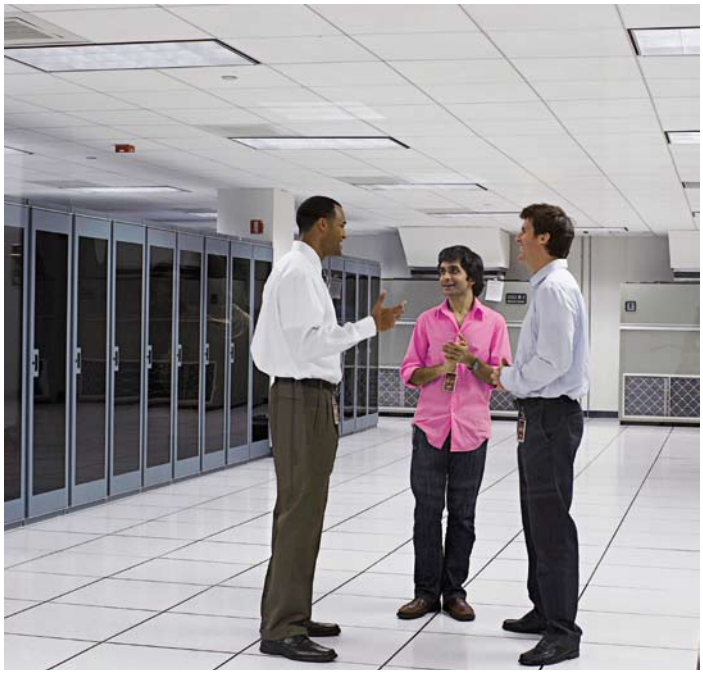
Fig. 8. Source: T-Systems 2009.

The findings of these simulations confirm the dynamic behavior of ICT infrastructures and how this influences energy consumption.
An overview of the results (five-year simulation):

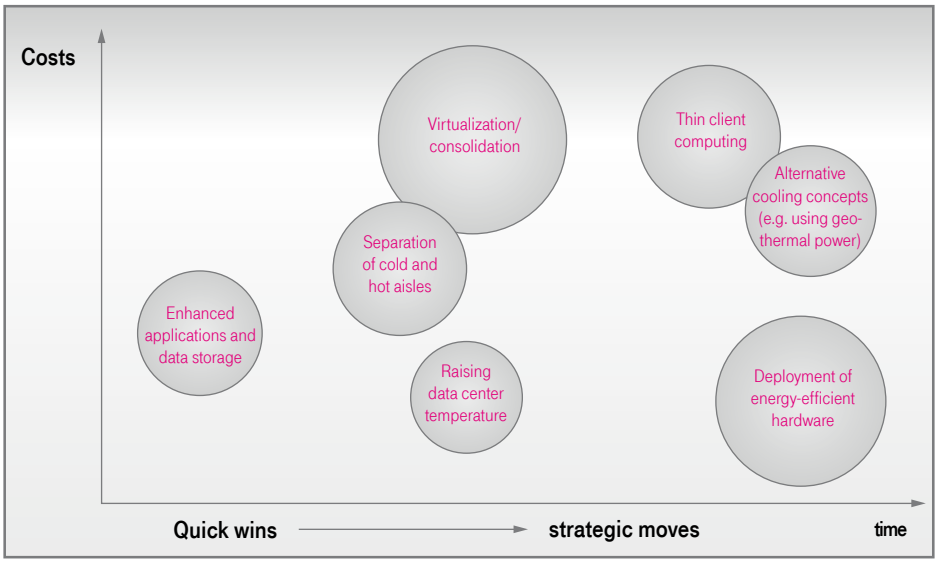
- Energy consumption reduced by 618,589 kWh.
- Costs reduced by € 43,301.
- CO_2 emissions reduced by 108.25 metric tons (an equivalent of a car traveling over 676,000 kilometers).

These savings can be achieved by reducing the total amount of hardware (by up to 80 %, with the aid of virtualization), lowering the number of servers (by up to 50 % by pooling and by raising utilization from 15 to 70 %) and optimizing operation of the infrastructure (a PUE value of 1.5 is feasible; data centers typically have a value of 2.5). The Green Dynamics model makes Green ICT more transparent and raises awareness of Green ICT issues both within and outside the organization, while clearly showing how the ICT industry can contribute to cutting global CO_2 emissions: www.t-systems.de/green-dynamics.

Now that we've taken a closer look at Green Dynamics, let's examine the following figure showcasing measures for improving energy efficiency in data centers.



Typical energy distribution in a data center.



Potential for boosting energy efficiency.

Fig. 9. Source: DENA.

3.3 Improving business processes with Green ICT.

By ensuring efficient workflows, reducing the number of vehicles on the road, and eliminating unnecessary paper consumption, CO_2 emissions can be greatly reduced. ICT also permits in-depth monitoring of energy consumption and CO_2 emissions throughout the value chain, so processes and organizational structures can be enhanced accordingly. Companies should consider how they can deploy ICT to simplify and streamline their core processes. Almost every enterprise could save tons of paper and cut their CO_2 emissions through dematerialization – for example, by choosing to communicate via email rather than post, moving to eBilling or archiving electronically. And thanks to the elimination of delivery time, for example, as well as the traffic that comes with it, workflows also become less time-consuming.

ICT offers scores of solutions to simplify core business processes such as HR, production and sales, ensuring efficient resource management and significant savings – and not just of CO_2 emissions.

The manufacturing sector is particularly resource-intensive, and the automotive industry is no exception. In the core processes of development and production, deploying ICT in a smart way can lead to extensive reductions. Virtualization software and design applications (computer-aided design) provide increasingly accurate and lifelike representations, making prototypes increasingly unnecessary in the development stages – or at least reducing the number that needs to be made. What's more, software-assisted energy-saving functions can be deployed in the vehicles themselves. For example, there is a feature available that temporarily switches the engine off when the car moves out of gear; when the car sets off again, it restarts the engine. CO_2 emissions can be reduced throughout the production value chain. ICT helps protect the environment, providing solutions for establishing networks, delivery vehicles and efficient resource management.

ICT can enhance the measures that are already in place, across a range of industries. The global SMART 2020 study divides business concepts into the categories of smart buildings, smart logistics, smart grid, smart motors and dematerialization. The study identified that in Germany, smart logistics offers the greatest potential for saving emissions (85 m metric tons CO_2e), followed by smart buildings with 42 m metric tons of CO_2e [BCG und GeSI 2010].

The main goal of smart logistics is to reduce traffic in industries where frequent deliveries are necessary. According to the European Commission, traffic jams and poor route planning account for 50 % of fuel consumption. Intelligent road transportation systems combine an array of applications to cut fuel consumption by up to 30 %, in conjunction with much lower CO_2 emissions – but with no loss of service quality.

Potential to reduce emissions in each of the SMART 2020 study areas.

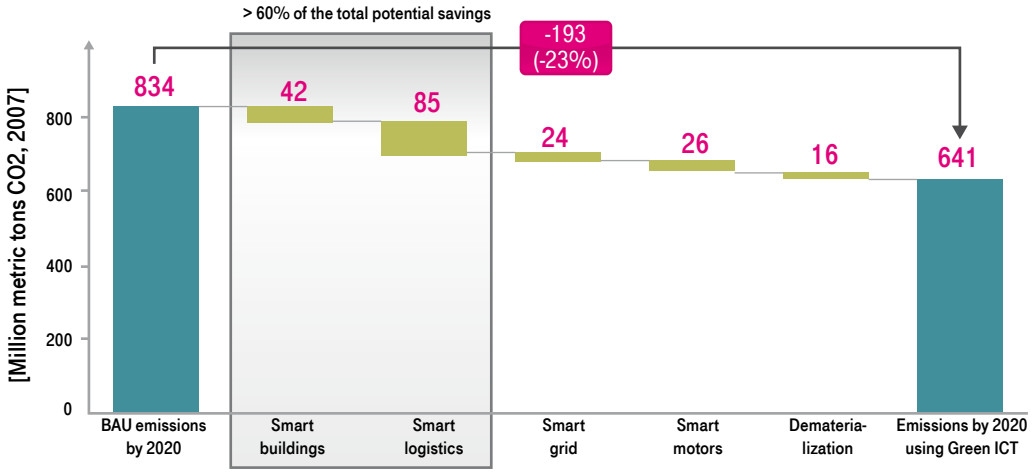


Fig. 10. Source: Smart 2020 Study.

Up-to-date, detailed traffic information – gathered by a network of devices and communicated via telecommunications technology – forms the basis of smart logistics systems. Journey planners and navigation systems use this information to calculate the best route for your vehicle and load, reducing the distances traveled, the time and fuel needed, and CO_2 emissions. Satellite and RFID applications pinpoint the precise position of vehicles, ensuring a highly efficient fleet. And these technologies can have a significant impact on sea and air transportation too – enabling the fuel consumption of air freight fleets, for example, to be cut by more than 10 %.

When building new offices and factories, companies need to take energy-saving measures into account. Smart buildings can combat rising energy consumption levels by using just a fraction of the energy of conventional buildings. But enterprises can also improve their existing premises. Innovative energy management systems can quickly and easily gear the amount of energy used for lighting, heating and cooling to the level actually needed.

Managing a building's energy consumption involves taking accurate measurements, revealing how energy is used and where reductions can be made – because there is often a lack of awareness about exactly how energy is consumed. Companies can have their heating and ventilation systems tested for energy efficiency and develop energy-saving lighting concepts. As well as saving costs and ensuring compliance with regulations, energy-efficient building management provides transparency, assuring customers that environmental targets are being met. Unfortunately, this is not deployed often – due to a lack of awareness of the benefits (cost savings, reputation, regulations etc.), and of clarity over responsibilities, as well as uncertainty surrounding legal requirements and customer wishes.

Buildings currently consume 40 % of global energy. By 2030, they will be responsible for half of the total CO_2 emissions. [Société Générale 2009]

3.4 Energy management is a core component of sustainability strategy.

Many companies have already developed sustainability strategies and launched energy efficiency initiatives. All too often, however, enterprises employ crude Excel spreadsheets or tools developed in-house to record and analyze their energy consumption. And in many cases, even these tools are being used only to glean data about specific buildings or departments. The time is ripe for businesses to focus on gaining enterprise-wide transparency into energy and resource consumption and carbon emissions. They also need to unify their energy-efficiency initiatives at executive level.

Against this background, deploying the right software is a key precondition for improving carbon emissions management, as most decision-makers agree. Asked how they wished to master the challenges of carbon data management, 44 % of respondents indicated that carbon software could help.

To address the many challenges of efficient, enterprise-wide energy management, IT solutions need to deliver on two main counts: First, they must provide complete transparency into current consumption at different levels of aggregation within the organization. And second, they must compare actual consumption figures with targets and with statistical reference data. This way, IT lays the right foundations for the efficient management of energy use (McKinsey 2009).

Solutions of this kind are generally called Enterprise Energy & Environmental Management (EEEM) systems. They need to support the following tasks:

- Consolidation and visualization of enterprise-wide energy and consumption data.
- Consumption-based carbon accounting.
- Processing of data for use in reports such as the sustainability or the CDP report.
- Development and evaluation of energy efficiency activities, e.g. against benchmarks and best-practice case studies.
- Management of energy efficiency activities and initiatives.

Much of the data required for these purposes is already available to companies in various places and formats. It follows, therefore, that a core task for those implementing an EEEM system – besides configuring the software – is to integrate it with existing corporate applications. These contain many of the facts and figures needed for carbon accounting and related reporting. In addition, interfaces – e.g. to smart metering or facility management systems – can be implemented for automatically forwarding data to the EEEM system. By exploiting software of this kind to consistently capture all consumption data and allocate it to the relevant parts of the organization, enterprises can perform sophisticated analytics and launch far-reaching energy efficiency initiatives. To give just a few examples, they can:

- Analyze consumption/emissions per organizational unit, department, building, cost center, or employee.
- Track and document consumption/emissions per customer, production unit, or service.
- Ensure the success of energy efficiency measures by assigning targets to employees.
- Evaluate the impact of rising energy/emissions prices on the price of a product or service.

Functionality of an EEEM system.

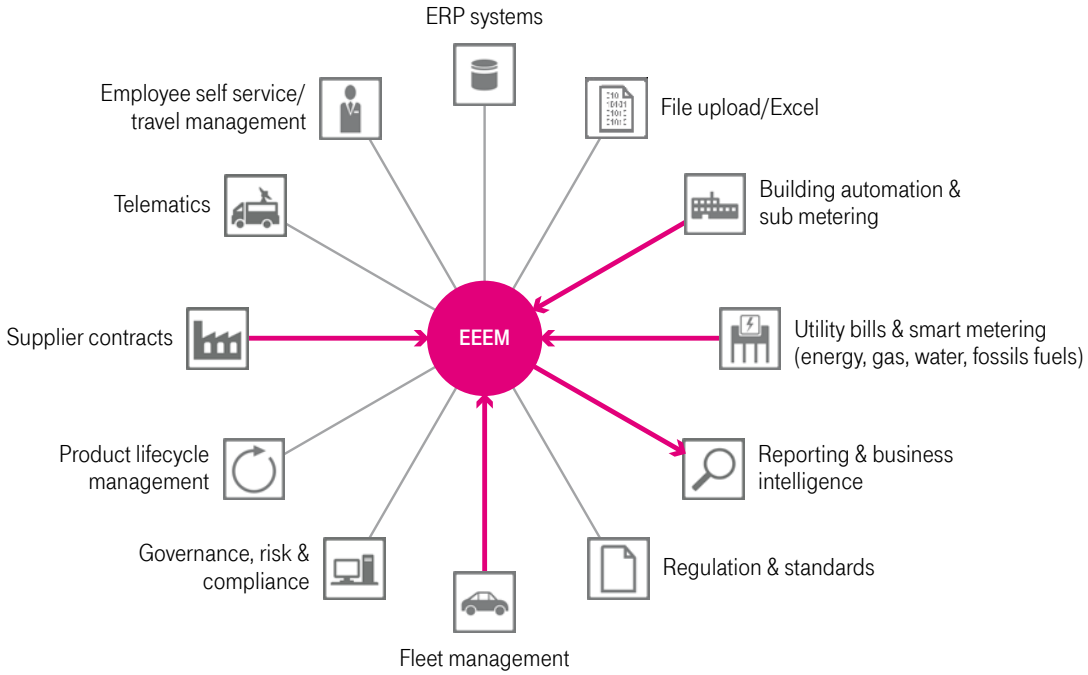


Fig. 11. Source: T-Systems 2010.

4. The Route to a Green ICT Action Plan?

Green ICT has been a major topic of conversation among industry professionals for some time – it is unlikely that any ICT decision-maker has managed to avoid all the articles in relevant publications, the systems showcased at CeBIT, and the intensive marketing efforts of providers. Green ICT technologies are now becoming increasingly popular. Unfortunately, however, they often lack a systematic approach. Without a cohesive, overarching plan, companies often initiate a variety of individual Green ICT projects but fail to effectively coordinate them. A comprehensive action plan sets out the strategic thrust and goals of Green ICT activities. This allows them to be coordinated, managed and harmonized as a whole. The individual activities can be aligned with the general goals, and implemented in logical order. An effective action plan gives all stakeholders – executive management, employees and customers – a framework of reference. It also makes it easier to realistically assess all potential savings, both environmental and economic. The motivation for implementing Green ICT technologies can vary considerably – ranging from a commitment to environmental protection to the wish to lower energy costs or improve a company's image. The first step must therefore be to evaluate and consolidate these often diverse goals and expectations to create a common understanding and shared acceptance.

After identifying expectations, it is necessary to take stock of the current situation: What Green ICT activities have already been initiated? How can they be combined and aligned? How can Green ICT be incorporated into the overall CSR strategy? What processes are involved in selecting hardware and suppliers? There is a further key point that needs to be addressed in advance: What obstacles have to be overcome, and what limits must be respected?

To strengthen support for the action plan, it is important to identify and reap "low-hanging fruit". A few simple steps, effectively presented and publicized, can be employed to attract the attention of employees and the general public to Green ICT efforts. These high-profile quick wins will build acceptance among employees, and heighten their interest and willingness to play an active role, even before the actual project gets under way. This can be achieved by, for example, disposing of obsolete legacy hardware, implementing an enterprise-wide power management system or joining an environmental protection organization.

Then you can proceed to tackle the action plan itself on a broad front. According to Forrester, the action plan must include the following top-priority tasks: review measurement methods, selection processes and technical support methods; optimize how the existing ICT environment is utilized; transform and upgrade infrastructure; and leverage ICT in core business processes.

It is vital for you to make comprehensive measurements and utilize software that delivers transparency. To make the success of a Green ICT strategy visible, you need to, for example, provide a detailed breakdown of data-center power usage. Many ICT managers remain unaware of exactly how much energy their systems consume. ICT and facilities management need to be integrated more closely, the results of measurements need to be available at all levels, and the CIO should be aware of the data center's energy costs. Existing processes, for example for selecting hardware and suppliers, should be extended to include measurable criteria for environmental protection. Next on the agenda should be thorough staff training: Employees must be made aware of the simple steps they themselves can take to reduce environmental impact – and they themselves must work on making those simple steps become second nature. Only when the workforce is informed about the company's environmental goals, and is committed to achieving them, will staff comply with the relevant policies and guidelines and take an active role in their continued development.

Even without investing millions in new infrastructure, the existing ICT environment offers huge potential for improvements, ranging from the correct disposal of hardware to improved data-center cooling (see Section 3). Redesigning and reengineering infrastructure are large-scale, strategic undertakings. In contrast to the "low-hanging fruit", projects like these cannot be carried out at short notice, but need detailed planning. Reengineering tasks could include introducing a thin-client landscape, the wholesale replacement of data-center hardware – or the systematic outsourcing of all data centers.

You can't manage what you can't measure.

Finally, the greening of ICT requires two things: ongoing monitoring – sustainability reporting that increases transparency and makes it easier to identify further possible levers – and feedback into the continuous improvement process of the findings and insight gained.

A Green ICT action plan.

Fig. 12. Source: T-Systems 2011.

5. Reference projects.

DHL parcel collection and drop-off points.
They are convenient for customers, and help reduce road traffic: All 2,500 of DHL's planned automated parcel collection and drop-off points in Germany have been in operation since the end of 2009. As a result, DHL has been able to cut the total distance driven by its trucks and vans by around 600,000 kilometers per year. Because multiple parcels can be deposited and picked up in just one place, the length of journeys can be slashed. DHL customers could also drive less – if they stop at the self-service units on their way to work or the shops, they could eliminate a total of 3.3 m vehicle-kilometers annually. This is the conclusion reached by a study carried out by business and transportation consultants KE-Consult. CO_2 emissions will fall by about 980 metric tons yearly if automated collection and pick-up points are installed throughout Germany, ensuring customers can reach them in 10 minutes or less by car. T-Systems is responsible for the smooth, reliable operation of the units – which are connected to a sophisticated, failsafe network infrastructure. The collection points transmit information on customer orders to a central service center where employees monitor processes. Emails or text messages are sent to customers notifying them when shipments are ready for collection.

- DHL collection and drop-off points reduce journeys for customers and DHL.
- All self-service units are fully automated and equipped with cutting-edge technology.
- DHL trucks and vans will drive 600,000km less per year, and customers 3.3 m km.
- 2,500 collections points reduce carbon emissions by almost 1,000 metric tons.

Road charging solution: Toll Collect.
Germany's intelligent road-charging system contributes significantly to climate protection. This is confirmed by Toll Collect, the organization responsible for the system: Four years after go-live, the share of trucks weighing over 12 metric tons equipped with low-emission technology has increased. The percentage of kilometers traveled on autobahns by the least eco-friendly trucks (category S1) dropped by two thirds from 3.7 to 1.1. The corresponding figure for S2-category vehicles fell from 32.8% to 10.7%. And the S3 category, which previously accounted for 63 % of kilometers driven, saw a reduction to 53%. In the future, technology will enable road charges to be calculated on the basis not only of vehicle classifications, but also of actual CO_2 emissions. At present, the system calculates charges for various types of truck that use the German autobahn network. Charges are based on mileage, truck size and the number of axles. Vehicles are equipped with an on-board unit (OBU) tracked by GPS satellites, enabling the position of the truck to be determined to within a few meters. The OBU utilizes pre-installed software and digital maps to calculate charges. These details are then sent via the mobile-phone network to the Toll Collect data center, which handles invoicing.

A telematics solution can cut each truck's diesel consumption by around 2,000 liters per year.

- Telematics solutions for freight transportation optimize fleet management, improve capacity utilization, and reduce the number of empty runs.
- Navigation systems help avoid congestion.
- Toll Collect, Germany's road-charging system has significantly increased the share of low-emission trucks through price incentives.
- High-performance simulation technology reduces the need for test drives and test flights.

Telematics project in China.
In early 2011, over 5 m vehicles were registered in Beijing. According to studies carried out during the Olympics, fine-particle pollution levels in the city exceeded the World Health Organization's recommendations by over 81%. Since inking a three-year contract in summer 2010, the German Society for International Cooperation (GIZ) and Deutsche Telekom have been testing a variety of emission-based payment systems in China. The aim is to find effective ways to curb CO_2 emissions in megacities. One of these is a "pay-as-you-pollute" program. During the World Expo in Shanghai, the project partners measured emissions generated by vehicles used by that event, laying the foundations for a pollution-based road charging system. They deployed smartphones containing a special app in a fleet of VIP shuttles. The app analyzes acceleration and braking, as well as profiles for individual routes. Using data supplied by vehicle manufacturers, the app can then calculate CO_2 emissions in real-time. Confronted by emission-based charges for roads in city centers, drivers could be incentivized to modify their driving styles.

In October 2010, DB Schenker, the major logistics player, became a participant in a field trial in China. T-Systems equipped five trucks with special smartphones. Other logistics enterprises are also taking an interest in green telematics, attracted by ability of these technologies to lower large fleets' fuel costs and emissions by around 10 %. According to a Frost & Sullivan study, the market for telematics applications for commercial fleets is set to increase from 80 m$ in 2008 to 700 m$ in 2015. This growth is primarily driven by the pressure to reduce carbon emissions and acquire a "greener" image:

- Partnership in China to promote low-emission driving behavior.
- This is technology-based: vehicles are equipped with smartphones containing apps that record and correlate driving behaviour with fuel consumption.

Smart metering at T-City, Brau Union Austria and Voltaris.

T-City.
Technische Werke Friedrichshafen (TWF) is the local utility in the northern Lake Constance region, in southern Germany. TWF has joined forces with T-Systems and ABB to explore new ways to deliver power, as part of the T-City initiative. The project addresses all the facets of smart energy: smart metering, smart grids and home automation. In two suburbs, Oberhof and Windhag, all households have been equipped with smart meters for electricity, gas and water.

T-Systems developed a modular solution: The electricity, gas and water meters are separate from the central data communication units, or multi-utility servers (MUS). Data from each meter is transferred to TWF reliably and in real-time, regardless of its format. As a result, TWF can leave it to households to decide how often the meters are read: They can choose to have their consumption data transmitted to TWF every quarter of an hour, for instance, or just once each day. This approach also minimizes the amount of data requiring processing – only as much data is transferred as is necessary. Thanks to the steady stream of information about consumption, TWF can keep abreast of peaks in demand. The utility is now offering households in Oberhof und Windhag flexible tariffs, rewarding consumers for using energy during off-peak periods.

- Two local government areas were equipped with smart meters.
- Consumers can proactively reduce usage, thanks to visibility into their energy consumption and the availability of flexible tariffs.

Between 2030 and 2050, teleworking solutions could lower developing countries' CO_2 emissions by 1.3 bn metric tons (421 mt CO_2 in China alone), while OECD members could save 876 mt. [WWF 2009]

Brau Union Österreich.
For leading Austrian beer producer Brau Union, T-Systems integrated an inventory management system and forklift control system, with an interface to the brewer's ERP system. This system helps the company keep its warehouses well-stocked with a wide variety of goods, in line with demand. What's more, using sensors and WLAN, resources can be located anywhere in the facility. Thanks to a screen built into their vehicles, forklift drivers can navigate quickly and directly to their destination. Brau Union has delivered on its commitment to green logistics by reducing the 14 forklifts' gas consumption. Shortening the routes traveled by the vehicles has cut CO_2-emissions by almost 15%. This is a lighthouse project for the global Heineken company, which owns Brau Union.

- Shorter routes have reduced the 14 forklifts' CO_2 emissions by almost 15 %.
- Better use of resources:
  →By increasing inventory turnover while deploying the same number of employees and forklifts.
  →By increasing the area used to store goods, because warehouse space can be used flexibly for any and all products, without requiring specific places to be reserved for specific items.

Voltaris.
Energy data management specialist VOLTARIS is responsible for around a million electricity, gas, water and heating meters. The company installs the devices and captures consumption data. Its customers, utilities, use this to bill consumers and develop new products, such as tariffs.
Since 2011, VOLTARIS has leveraged Deutsche Telekom's meter-reading service. Available across Germany and capable of handling large volumes of data, this service will enable VOLTARIS to install and operate up to 100,000 digital meters over the next five years. These will automatically transfer readings to multi-utility servers (which are also being installed). A highly available connection whisks the consumption data to Deutsche Telekom's smart metering platform. Here, the numbers are crunched and transferred to VOLTARIS' data center. This solution puts VOLTARIS at the cutting edge of meter management. Client utilities can boost customer loyalty through new tariff models, plus home energy management services and other energy-efficiency offerings. By moving to smart metering, VOLTARIS is helping to lay the technological foundation for the smart grids of the future.

- Comprehensive meter reading service with reliable data transmission.
- Lays the foundation for smart grids.

Telepresence solution for BG Holz und Metall.
Four major German professional associations have merged to form Holz und Metall (BGHM). The new body turned to T-Systems for an end-to-end video conferencing solution. This links BGHM's three main offices, Mainz, Munich and Düsseldorf, and allows employees to hold ad hoc conferences with high audio and video quality. As a result, BGHM has slashed its travel expenses, improved the quality of decision-making, accelerated its integration and helped to protect the environment.

- High end-video conferencing reduces the need for travel, saving time and money.
- Lower CO_2 emissions.

According to ABI Research, the number of smart meters deployed around the globe will climb from 95.5 m (2010) to more than 200 m (2016).

6. Conclusion.

The issues of climate change and environmental protection have been debated for decades. Now they have become part and parcel of day-to-day business reality; companies are accepting responsibility for the CO_2 emissions they cause and are taking action.

ICT has, in many ways, a vital role to play. It accounts for about 2 % of global CO_2 emissions, which must, and can, be curtailed. In addition, through the intelligent use of ICT solutions to support business processes in other industries, it can help curb emissions.

The deployment of Green ICT makes a valuable contribution to the environment and sustainability. And businesses themselves benefit. Many of the approaches presented in this document are associated with lower costs, especially those that target energy consumption. They also improve a company's image, and noticeably raise customer and employee satisfaction. And as policymakers increasingly address climate change, new legislation and regulations on ICT can be expected in the near future. So organizations are well-advised to act now.

Organizations are adopting more-sustainable business models that focus on holistic corporate performance, efficiency and business value, as well as enhancing or protecting brands through increased transparency and investment in social capital. [Gartner 2011]

Some approaches are already being practised now. According to the German Business Travel Association (VDR), 65 % of German enterprises are already using telephone and video conferencing systems to minimize business travel. And according to the Experton Group, 65 % of German enterprises are virtualizing their servers.

Every organization has its own unique situation, and the first step should therefore be to analyze it. We have already described possible approaches for business processes, data centers and office environments. Quick wins can be achieved by harvesting "low-hanging fruit", for example by encouraging more energy-efficient use of office equipment or duplex printing. Greater potential is available through partnership with an external ICT service provider.

For example, an external provider can add value through their expertise in videoconferencing or electronic archiving, or – like in the case of Dynamic Services – its professionally organized and operated data centers. But be warned: It is vital to plan carefully before modifying business processes. When properly implemented, these measures promise excellent, and lasting, improvements. But it is essential to proceed systematically while coordinating and consolidating all of your Green ICT efforts.

7. Glossary.

Term	Definition
Carbon footprint	A company's total CO_2 emissions.
CDP	The Carbon Disclosure Project (CDP) is a NGO with the world's largest database of primary data from businesses relating to climate change. Thousands of organizations worldwide measure and publish their greenhouse gas emissions, water usage and environmental strategies via CDP.
Cloud (computing)	An approach whereby generalized IT infrastructures are adapted to meet requirements and made available via a network, with usage-based billing.
CO_2e	Carbon dioxide equivalent: every greenhouse gas can be converted into a corresponding amount of carbon dioxide (CO_2) with the same warming effect. For example, 1 kg of methane (CH_4) corresponds to 21 kg of CO_2, according to the Intergovernmental Panel on Climate Change.
CSR	Corporate social responsibility; this describes voluntary responsible and sustainable action by a company to the benefit of society, the environment or the economy.
Dematerialization	Redesigning products in view of the consumption of materials and energy throughout the product's lifecycle
Dynamic Services	A T-Systems offering that makes ICT resources available in accordance with actual demand, for example processing power, storage or SAP applications.
eBilling	Electronic invoicing
HVAC	Heating, Ventilation and Air Conditioning
ICT	Information and Communication Technology
Multi-Utility-Server	Hardware system for reading and transferring relevant data from a variety of sources (meters).
NGO	Non-govermental organization; a typically nonprofit organization without any government involvement.
Power Management	The ability to have electric devices (copiers, computers and peripheral devices such as monitors or printers) switch to power saving mode or shut down when not in use.
PUE Wert	Power Usage Effectiveness. The PUE value shows how efficiently a data center uses power. It compares the total amount of energy used by the data center and the amount used to power the IT devices themselves.
Smart building	A building with systems that are ICT-enabled; they can include heating, lighting, multimedia systems, household appliances, bathroom equipment, and connections to external networks such as the Internet.
Smart grid	An intelligent electricity grid, which provides a flexible energy supply by monitoring the energy usage of all devices connected to the network.
Smart meter	Intelligent electricity meter, which communicates energy usage data to the power supplier.
Smart motors	"Smart motors" includes all solutions involving the implementation of ICT in order to boost efficiency and reduce energy usage.

Term	Definition
Telepresence	Complete videoconferencing service package which simulates real-life interaction as closely as possible.
Thin client	A desktop computer with functionality limited to input/output. The operating system and applications run on central servers and are centrally administered.
UPS	Uninterruptible Power Supply. UPS provides protection against power failure, power surges and sags, and momentary spikes in power input.
Virtualization	The provision of virtual (i.e. non-physical) ICT resources.

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